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FAST HANDOVER TECHNIQUE USING MOBILE IPv6

Abstract

Mobile IP

IP is internet protocol to keep the connection without changing the IP Address when the mobile nodes move from one network to another.

In many applications, sudden changes in network connectivity and IP address can cause problems. Mobile IP was designed to support seamless and continuous Internet connectivity.

Mobile IP is most often found in wired and wireless environments where users are mobile. In the current mobile network context, a Mobile Node can change its point of attachment to different networks.

In order to keep the connection without changing the IP address, the Internet Engineering Task Force (IETF) presented the definition of (MIPv4, 6) (mobile internet protocol version 4, 6).

IP version 4: It assumes that a node's IP address uniquely identifies the node's point of attachment to the Internet. Therefore, a node must be located on the network as indicated by its IP address in order to receive datagram's destined to it. Otherwise, datagram's destined to the node would be undeliverable. To be able to change the attachment point of a node without losing its ability to communicate, a new scalable mechanism is required for accommodating node mobility (MIPv6).

Mobile IPv6:IPv6 provides mobility support for IPv6. It allows you to keep the same internet address all over the world and allows applications using that address to maintain transport and upper-layer connections when changing locations.

But frequently that basic Mobile IPv6 has many difficulties in perverting system quality in handover process. This problem has attracted the attention of many research groups and also earned certain achievements. This research focuses on analyzing, comparing and synthesizing published Mobile IPv6 fast handover techniques. Based on these approaches, wewill be proposing an innovative method using our knowledge about Mobile IPv6 Handover Problem to improve the handover performance of it by reducing the latency.

Through this technique we will be suggesting a better mechanism in mobile IP to get fast handover by reducing the latency as far as possible.

Keywords – Mobile IPv6, Fast Handover, Handoff, IP mobility, MIPv6, FMIPv6.

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1. Introduction

With the prevalence of powerful notebook computers and wireless communication devices, people need to connect to the internet at any time and in any location. The Mobile IPv6 specification enables hosts to change their point of attachment to the Internet while not breaking existing application sessions. The process that a Mobile Node (MN) changes its point of attachment to the network or moves from one network to another network is known as handoff or handover.

In the next mobile network technologies, when the MN usually changes its point of attachment to the Internet, the handover performance needs to be improved, especially the latency.

1.1 Mobile IP

1.1.1 Introduction to Mobile IP

With the prevalence of powerful notebook computers and wireless communication devices, people need to connect to the internet at any time and in any location. Unfortunately, previous Internetworking protocols like TCP/IP behave awkwardly when dealing with host migration between networks. If a mobile host moves to a new network while keeping its IP address unchanged, consequently, existing routing protocols will be unable to route data grams to it correctly. In this situation, it will cause already-established transport layer connections.

In order to keep the connection without changing the IP address, The Internet Engineering Task Force (IETF) presented the definition of MIPV6(Mobile IP version 6) in RFC3775 in2004, Mobile-IPV6 is an enhancement to IP which allows computer to roam freely on the Internet while still maintaining the same IP address.

The Mobile-IP architecture defines special entities called the Home Agent (HA), Foreign Agent (FA), Correspondent Nodes (CN), Mobile Host (MH) or Mobile Node (MN), Previous Access Router (PAR), New Access Router (NAR) and Access Point (AP). Each Mobile Host is associated with a unique home network as indicated by its permanent IP address.

Normal IP routing always delivers packets meant for the MH to this network. When a MH is away, a specially designated computer on this network its Home Agent is responsible for intercepting and forwarding its packets.

The MH uses a special registration protocol to keep it's HA informed of its current location.

Whenever an MH moves from its home network to a foreign network or
from one foreign network to another, firstly, it obtains a care-of address (CoA),then sends a Binding Update (BU) to its HA. After a successful registration, packets arriving for the MH on its home network are encapsulated by it's HA and sent to MN by MN's CoA.

1.2 Mobile IPv4 Overview

IP version 4 assumes that a node's IP address uniquely identifies the node's point of attachment to the Internet.

Therefore, a node must be located on the network as indicated by its IP address in order to receive datagram's destined to it; otherwise, datagram's destined to the node would be undeliverable. For a node to change its point of attachment without losing its ability to communicate, currently one of the two following mechanisms must typically be employed:

1. The node must change its IP address whenever it changes its point of attachment.
2. Host-specific routes must be propagated throughout much of the internet routing fabric.

Both of these alternatives are often unacceptable. The first makes it impossible for a node to mention transport and higher layer connections when the node changes location. The second has obvious and server scaling problems, especially relevant conceding the explosives growth in sales of notebook (mobile) computers.

A new scalable mechanism required for accommodating node mobility within the Internet.

1.3Mobile IPv6

1.3.1 Introduction to Mobile IPv6

Mobile IPv6 provides mobility support for IPv6. It allows you to keep the same internet address all over the world, and allows applications using that address to maintain transport and upper-layer connections when changing locations. It allows mobility across homogenous and heterogeneous media. For example, Mobile IPv6 facilitates node movement from an Ethernet segment to a wireless LAN cell while the mobile node's IP address remains unchanged.

In Mobile IPv6, each mobile node is identified by two IP addresses: its home address and its care-of address. The home address is a permanent IP address that identifies the mobile node regardless of its location.

The care-of address changes at each new point of attachment and provides information about the mobile node's current situation. When a mobile node arrives to a visited network, it must acquire a care-of address, which will be used during the time that the mobile node is under this location in the visited network. It may use the methods of **IPv6** Neighborhood Discovery to get the care-of address. Both stateless and state full auto-configuration is possible. The care of address can also be manually configured. How the care of address is acquired is irrelevant to Mobile **IPv6**.

1.3.2 Differences between Mobile IPv4 and Mobile IPv6

- There is no need to deploy special routers as "Foreign Agents", as in Mobile IPv4. Mobile IPv6 operates in any location without any special support required from the local router.
- Support for route optimization is a fundamental part of the protocol, rather than a non-standard set of extensions as IPv4.
- Mobile IPv6 route optimization can operate securely even without pre-arranged security associations.
- It is expected that route optimization can be deployed on a global scale between all mobile nodes and correspondent nodes.
- Support is also integrated into Mobile IPv6 for allowing route optimization to coexist efficiently with routers that perform "ingress filtering".
- The IPv6 Neighbor Unreachability Detection assures symmetric reach ability between the mobile node and its default router in the current location.
- Most packets sent to a mobile node while away from home in Mobile IPv6 are sent using an IPv6 routing header rather than IP encapsulation, reducing the amount of resulting overhead compared to Mobile IPv4.
- Mobile IPv6 is decoupled from any particular link layer, as it uses IPv6 Neighbor Discovery instead of ARP. This also improves the robustness of the protocol.
-
- The use of IPv6 encapsulation (and the routing header) removes the need in Mobile IPv6 to manage "tunnel soft state".

- The dynamic home agent address discovery mechanism in Mobile IPv6 returns a single reply to the mobile node. The directed broadcast approach used in IPv4 returns separate replies from each home agent.

1.4 The Basic Mobile IPV6 Handover

Access Routers periodically multicast unsolicited RA message. When the MN receives RA, it compares the IP address in RA with its HoA (Home Address) to detect that whether it has moved to a new network. The two continuous RA messages take the time (RA period) between the minimum RA Interval (30ms) and the maximum RA Interval (70ms). To reduce the movement detection time, the MN can send RS (Router Solicitation) message to request AR reply RA for it. However, there must be a data link layer trigger in this case. The MN configures new CoA using information in RA.

Next, the MN needs to verify the uniqueness of its new CoA on the new link through DAD (Duplicate Address Detection) procedure. In order to perform DAD, the MN has to send one or several NS (Neighbor Solicitation) to its new CoA and wait for a response for at least one second. This produces important additional time to handover latency.

Once the new CoA construction is done, the MN must update the binding cache in itsHA and CN by sending a Binding Update (BU) message.

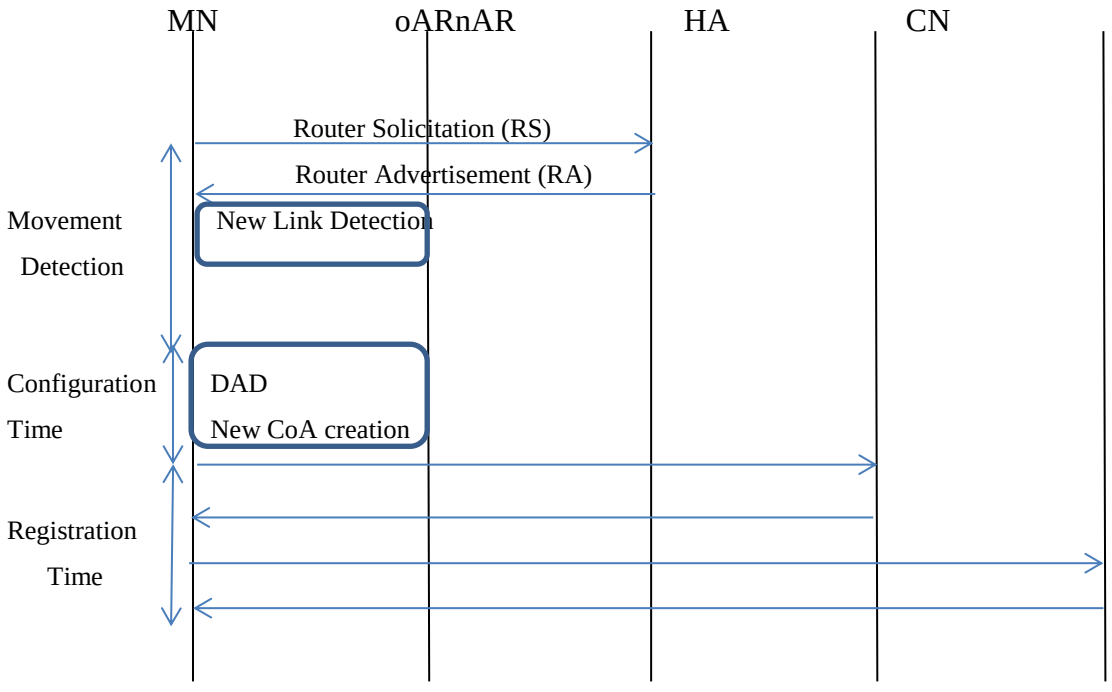

Figure.1 Mobile Handoff

1.5 Handover Problem

When a MN changes its point of attachment to the network, it moves from one network to another new network. During this process, the MN usually has disconnected from the old network before connecting to the new network (especially if using a single interface) and thus there is a time when the MN has lost connectivity to the Internet. During this period it cannot send or receive IPv6 packets to maintain existing application sessions. This process is known as handoff or handover.

1.6 The Discovery process

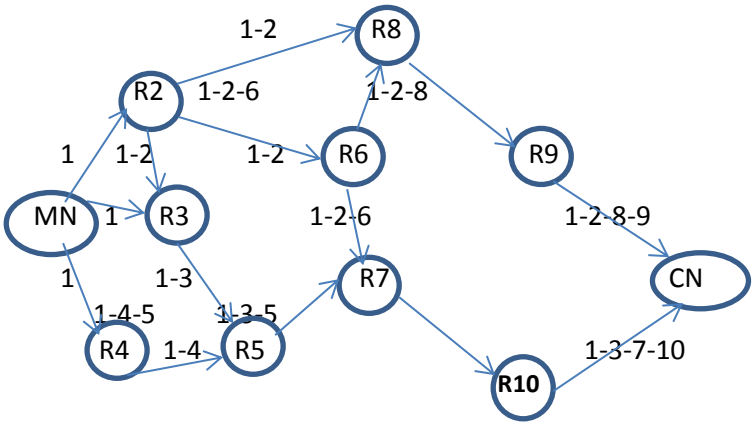

Figure.2 Source node MN initiates path discovery process (Send RS)

First step: For route discovery, the source node starts by broadcasting a route request packet that can be received by all neighbor nodes within its wireless transmission range. The route request contains the address of the destination host, referred to as the target of the route discovery, the source's address, and a unique identification number.

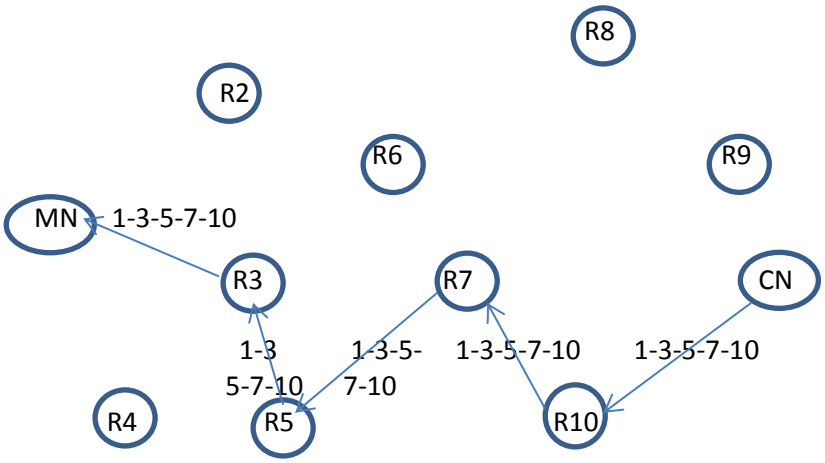

Figure.3 MN receive RA

Second step: At the end, the source host should receive a route reply packetcontaining a list of network nodes through which it should to move, supposed the route discovery process was successful.

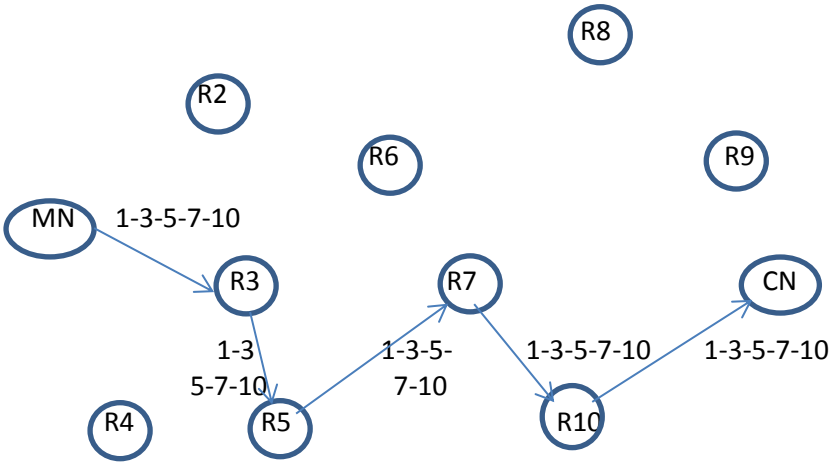

Figure.4 MN send packet to CN

Third Step: At the final, the source host (MN) should receive a route reply packet containing a list of network nodes through which it should propagate the packets, supposed the route discovery process was successful, and in the final we can make sure that in that way no loops will occur during send the packets.

2. Related Work

In the current mobile network context, a Mobile Node can change its point of attachment to different networks so frequently that basic Mobile IPv6 has many difficulties in prevising system quality in handover process.

This problem has attracted the attention of many research groups and also gained certain achievements. Our study focuses on analyzing, comparing.

In [2] there are a various techniques typical research works which have been proposed:

1st. There is technique using RA caching in AP (Access Point) to help MN for fast Access Router discovery reduces movement detection time of MN. In this technique, the AP is added two functions that are “RA Caching” and “AP Notification”.

“RA Caching” caches RA message beforehand and sends it to a MN as soon as L2 association is made. Concretely, the AP scans all incoming L2 frames.

It scans L2 frame header to see whether it is a multicast frame. If not, the AP sends that frame down link and scans next L2 frame. If so, the AP looks IP header to check whether it contains unsolicited RA from an AR.

If incoming L2 frame doesn’t contain unsolicited RA, the AP sends that frame down link and scans next L2 frame.

When the AP finds unsolicited RA, it stores that frame and sends a copy down link.

When a MN moves to a new AP, it sends Association Request Message with its MAC address. Then, the AP grants association by sending Association Response Message. At that time, MN associates with the AP. As soon as association is made, the AP sends stored RA to the MN with MAC address in Association Request message. In this technique, MN receives RA just after association is made which is the earliest possible time in current standard.

2nd. The technique using RA cache in the handover module on MN [3] provides the MN with the capability of filtering RAs to avoid the default processing of handover. The MN receives and processes cached RAs immediately after it moves to a new network and thus movement detection time is reduced. In addition, the priority of the RAs stored in the cache enables the MN to determine the best AR to connect. Four criteria are used to determine the priority of the RAs stored in the cache (sorted by the importance):

- The link signal strength (signal quality)
- The time since the RA entry was last updated
- The number of hops to the AR on the foreign network
- whether or not the AR is link local (priority is given to link local ARs since this may help the MN to detect that it is still reachable via its current IP address).

In [21] they recognize that the DAD time is significant during a handoff and they propose a scheme for HMIP in order to reduce the DAD time on handoff delay. The scheme is called Stealth-time HMIP (SHMIP) and assigns a unique on-link care-of address (LCoA) to each mobile node and switches between one-layer IPv6 and two-layer IPv6 addressing. In this mechanism when a mobile node sends a local BU, it also sends Bus to its home agent and correspondent nodes at the same time, using LCoA instead of RCoA. To further reduce packet losses, they also adopt pre-handoff notification to request previous mobility anchor points (MAP) to buffer packets for the mobile node.

In [5] the total handover latency MIPv6 is found to be 5 seconds. Based on the authors" assumptions, if the L2 handover takes about 1 second, then the remaining 4 seconds are used for the L3 handover. This happened because the minimum period of RA (Router Advertisement) was 3 seconds and the maximum period was 5 seconds which corresponds to the default setting in wired IPv6.

In MIPv6 these values are expected by the RFC to be smaller.

In a subsequent paper [10] the same authors consider that the router advertisement (RA) message is sent to wireless link in every 1-3 seconds which is a better interval, but as we will show in Section IV it can also be considered large.

Especially for the mobile users with relatively high mobility and long distance to their HAs. This problem becomes worse with the increase of the mobile users population.

Moreover, if a user is far away from his/her HA or the HA processing capability is overwhelmed by the huge volume of update messages, the signaling delay for the location update could be very long, which will result in the loss of a large amount of in-flight packets and the degradation of quality-of service(QoS). We must find a way to reduce the Handover latency and data loss. But Mobile IPv6 doesn't present additional optimizations to handover problem; it can't meet the need of seamless handovers. Therefore many experts and group suggest suitable improvements to the protocol.

2.1Handoff Delay Analysis

Under the MIPv6 protocol, the handoff delay is defined as the time duration from the MN receives the Fast Binding Acknowledgment (F-Back) from the oAR with which it is currently associated until the MN receives the Fast Neighbor AdvertisementAcknowledgment (F-NAack) from the nAR. The total handoff delay of MIPv6, can be represented as

$$TMIPv6 = {}^{T}MN-AR + {}^{T}AR-MN + {}^{T}dis \quad (1)$$

Where,

TMIP = Total time of handoff delay of mobile IP,

${}^{T}MN-AR$ = time mobile node- access router

${}^{T}AR-MN$ = time mobile access router-mobile node

${}^{T}dis$ = time disconnection

${}^{T}MN-AR$=Time delay for sending a signaling message from an Mobile Node to an Access Router,

${}^{T}AR-MN$ = Time delay for sending a signaling message from an Access Routerto an Mobile Node,

T_{dis} = Time for disconnection.

Signaling Delay from MN to AR (${}^{T}MN-AR$)

Before an MN sends a signaling message to a corresponding AR; it spends some time on generating the message, accessing the wireless channel, and transmitting the message out.

Hence, ^{T}MN−ARconsists of the following delay components:

$^{T}MN-AR = {}^{T}MN-serv + {}^{T}MN-col + {}^{T}MN-prop$ (2)

Where;

^{T}MN−serv = Time mobilenode service

^{T}MN−col = Time mobile node collision

^{T}MN−prop = Time mobile node-propagation

^{T}MN−serv: is message service delay time which includes the message processing and transmission delay,

^{T}MN−col is random delayed time due to collision avoidance for an MN to access the wireless channel,

^{T}MN−prop is propagation delay of the signaling message over the wireless link.

Signaling Delay from AR to MN (^{T}AR−MN):

After receiving the signaling message from the MN, the AR processes the message and generates a response. Similar to the above analysis, ^{T}AR−MN can be expressed as:

$^{T}AR-MN = {}^{T}AR-serv + {}^{T}AR-col + {}^{T}AR-prop.$ (3)

Where,

^{T}AR−serv = Time access router service

^{T}AR−col = Time access router collision

^{T}AR−prop = Time access router propagation

Disconnection Delay (T_{dis}):

Disconnection time refers to the time when the connection between the MN and oAR is released and before the MN sets up the new connection with the nAR. During this disconnection time, packets destined to the MN will be forwarded from the oAR to the nAR and buffered at the nAR.

There are two L_2 triggers used by ARs as a reference to break or start a link. The first trigger is the layer 2 link down trigger (L_2-L_D) which indicates that the L2 link between the MN and oAR is broken.

When the oAR receives this trigger, it starts to forward the packets to the nAR through a tunnel. The second trigger is the layer 2 link up trigger (L_2-L_U) which occurs when the L_2 link between the MN and nAR is established. When the nAR receives this trigger, it begins to forward the buffered packets to the MN.

Therefore, the value of disconnection time is the sum of the time it takes to receive the L_2-$L_D$and L_2-$L_U$triggers, i.e.

$T_{dis}={}^{T}L2-LD^{+T}L2-LU$ (4)

As it can been seen from Figure 1, the overall MIPv6 handover latency can be reduced by direct manipulation of a number of parameters. Solutions like HMIPv6 and FMIPv6 manage to reduce the BU/Registration Delay. In our work we focus on the delay of DAD.

Where:

(L_2-L_D) = layer 2 link down trigger

(L_2-L_U) = layer 2 link up trigger

3. Description of Broad Area/Topic

Over the internet during a communication there is a datagram which is to be moved from one network to another or from one subnet network to another sub network and there are a problems when datagram is moved. It takes a time and also there are some packets which are lost. In this research we will make a study and make analysis of the already existing techniques to develop the process of handoff or handover.

My broad area of the research work would be to design an algorithm of fast handover for mobile IPv6.

- Home Agent node:

Maintain an entry in its binding cache for each mobile node for which it is serving.

Intercept packets addressed to a mobile node for which it is currently serving as the home agent, on that mobile node's home link, while the mobile node is away from home.Encapsulate such intercepted packets in order to tunnel them to the primary care-of address for the mobile node indicated in its binding in the home agent's binding cache.Return a binding acknowledgment option in response to a binding update option received with the acknowledge bit set.

Process the Duplicate Address Detection on the mobile node's care-of address to ensure the IPv6 addresses are unique.

Support Dynamic Home Agent Address Discovery to assist the mobile nodes is discovering the addresses of the home agents.

Support the reception of Mobile Prefix Solicitation and the sending of Mobile Prefix Advertisement.

- Stationary Correspondent node:

Process a home address option received in any IPv6 packet.

Process a binding update option received in a packet and to return a binding acknowledgement option if the acknowledge.

Maintain a binding cache of the bindings received in accepted binding updates

Send packets using a routing header when there is a binding cache entry for a mobile node that contains the mobile node's current

- Router node in a Network visited by the mobile node:

Send an advertisement interval option in its router advertisements to aid movement detection by mobile nodes.

Support sending unsolicited multicast router advertisements at the faster rate.

Send a Home Agent Information option (home agent preference and lifetime) in itsrouter advertisements to aid mobile nodes to choose their home agent care-of address.

3.1 Mobile IPv6 fast handover Techniques

In general, there are two ways to extend the handover mechanism, based on entities in the network infrastructure and based on MN:

- The first way is to make modifications or add extensions to the entities in the network infrastructure such as routers, base stations. Routers or base stations can be changed so that they will only send RA to the MN when a handover is necessary as opposed to periodically sending RAs as the basic Mobile IPv6.

This means the approximate location and signal strength of the MN need to be cached in nearby routers or base stations.

- The second way is to make modifications or add extensions on the MN. In this case, it is the MN that decides when a handover is appropriate.

3.1.1 Issues of existing Techniques

There are several of problems in Mobile IPv6 handover, but the important issues are:

- To minimize the latency handover process in Mobile IPv6.
- Previous techniques have included several solutions to reduce latency handover, but didn't solve the problem completely and took more time.

Through our proposal we will work to get the handover time is less compared to the previous theories.

Objective of the Study

The objective of research is to suggest a better mechanism of route optimization for faster handover using mobile IPv6 comparing with already available mechanisms.

It is working towards development of mechanism to achieve:

- Fast handover: By effective mechanism which will assist to discover the optimized route by browsing through the information stored in cache memory and hence to achieve faster handover.
- Zero-Packet loss: Effective transfer of data without the loss of any packet.
- The best way to communicate between the mobile node and correspondent node by this technique and through the development of one of the already existing techniques to find out all the positive characteristics as well as the flaws in the technique.

Methodology

Our research work would be carried out in phases to find the main objectives of the research, to study the issues related to the Handover in the mobile IP, with an aim to get faster Handover by proposing or developing a mechanism.

Phase1: Study for the literature survey on the topic and work on course work subjects.

Phase2: Study available tools, existing mechanisms and categorizing the issues and challenges with them.

Phase3: Identify the areas of improvisation to make the handover faster and without packet loss, and also to publish the research study and work.

Phase4: Identifying optimal ways, parameters for faster handover and zero packet loss through the optimization and to propose or develop an improvised mechanism in a simulated environment to authenticate the work with research paper Publications.

Phase5: Final report writing, reviewing of thesis and submission.

4. Proposed expected outcomes of the research

The main idea of research is to propose a handover technique in order to solve that problem based on MN (Mobile Node) to extend Mobile IPv6 handover mechanism. We suggest supplementing an additional procedure AR (Access Router) buffering to MN for storing all the Access Routers that it connected in the past.

Every record in AR buffering contains information of AR which it connected to, CoA address, connection instant, and connection interval. When MN moves, it will perform data mining in AR buffering to predict the direction of movement.

The predicted direction is the one towards AR to which it connected the most; with the top priority is connection instant. At that time, MN sends RS message to the nAR where it predicted that it is coming.

If MN receives RA message from nAR, MN will search the corresponding CoA in AR buffering instead of re-configuring CoA based on RA as in basic Mobile IPv6. Consequently, in this case, CoA and DAD configuration procedures are skipped so the latency is reduced significantly.

Therefore, a MN usually moves through a certain number of routers and the movement direction of MN depends heavily on travel time.

As a result, we can use the movement history of MN to predict its movement direction. In this mechanism, we propose to add a buffer to MN to store the information about all of its connections in the past, known as AR buffering.

When MN moves, it will query AR buffering to determine AR to which it often connected based on time travel. The query result is a list of ARs arranged in order of the number of times that the MN connected to. These are ARs where MN predicted that it is coming. At that time, MN sends RS message to ARs in the list in order of priority. The AR accepts the request of MN by sending RAmessage to MN. Thus, MN can discover AR during its movement, so movement detection delay is reduced.

4.1 Duplicate Address Detection

Once the MN discovers a new router and creates a new CoA it tries to find out if the particular address is unique. This process is called Duplicate Address Detection and itis a significant part of the whole IPv6 process, with very little room for improvement. **In this work we evaluate MIPv6 Handover's when this feature is disabled.**

5. References

1. Al Shidhani, Ali A. ; Leung, Víctor P C M "Secure and Efficient Multi-Hop Mobile IP Registration Scheme for MANET-Internet Integrated Architecture" Wireless Communications and Networking Conference,10.1109/WCSN.2009.5434791 (WCNC), 2010 IEEE, Publication Year: 2010 , Page(s): 1 - 6
2. ArunPrakash, Rajesh Verma, Rajeev Tripathi, and KshirasagarNaik "Extended Mobile IPv6 Route Optimization in Nested Mobile Networks" International Journal of Mobile Computing and Multimedia Communications (IJMCMC),Volume 2, Issue 17 pages.2010.
3. Cong Hung. TRAN a, Van T.T DUONG 'Mobile IPv6 Fast Handover Techniques Published in: Advanced Communication Technology (ICACT), 2011 13th International Conference on Date: 13-16 Feb. 2011, Page(s): 1304 – 1308
4. Deguang Le, Jinyi Chang "Tunnelling-Based Route Optimization for Mobile IPv6"Wireless Communications, Networking and Information Security (WCNIS), 2010 IEEE International Conference, Page(s): 509 – 513, 2010
5. D-H Kwon, Y-S Kim, K-J Bae, and Y-J Suh "Access Router Information Protocol with FMIPv6 for Efficient Handovers and Their Implementations" IEEE GLOBECOM 2005.
6. FAN Xiumei GUO Xu WANG Liping "An intelligent mobile IP routing algorithm based on the active network", Communications and Mobile Computing, 2009. CMC '09. WRI International (Volume:2), Page(s): 253 – 258, 2009
7. Farahbakhsh, R, "Smooth handover by synchronizing context transfer protocol and fast mobile IPv6", Internet Multimedia Services Architecture and Applications (IMSAA), 2009 IEEE International Conference, Page(s): 1– 5, 2009
8. Fayza nada "performance analysis of Mobile IPv4 and Mobile IPv6" The international Arab journal of information technology, vol 4, No 2, April 2007.
9. Jong-Hyouk Lee∗, Sri Gundavelli, and Tai-Myoung Chung "A performance analysis on Route Optimization for Proxy Mobile IPv6" Published in:Communications, 2009. ICC '09. IEEE,Page(s):1– 6, 2009

10. Jahangir khan “Handover management in GSM cellular system”School of computer science, PAF-KIET, Pakistan Air Force Base, korangiCreek Karachi 75190 Pakistan International Journal of Computer Applications (0975 – 8887)Volume 8– No.12, October 2010.
11. Huachun Zhou, Hongke Zhang, Yajuan Qin, " A Fast Handover Scheme of PMIPv6 and Performance Analysis", Fourth International Conference on Systems and Networks Communications, Vol. 8 No. 4, P.535-543 (2010)
12. Hanh Van Nguyen; Soonghwan Ro; JungkwanRyu; Yong-Geun Hong, "A Temporary Binding Update in Fast Handover for Mobile IPv6", Convergence Information Technology, 2007. International Conference on, Page(s): 432 – 437, 2007
13. Lin, Phone ; Cheng, Shin-Ming, Liao, Wanjium “Modeling Key Caching for Mobile Authentication, authorization, and Accounting (AAA) Services” Vehicular Technology, IEEE Transactions, Volume: 58 , Issue: 7, Page(s): 3596 – 3608, 2009 ,.
14. SeungBeom Lee, KyeongHur, Jong-Kook Kim, Doo-SeopEom "A handoff packet marker for diffserv in mobile IP-based networks with packet buffering", Consumer Electronics, IEEE Transactions, (Volume:55, Issue: 2), Page(s): 438 - 445
15. Man Kyu Park, Jae Yong Lee ; ByungChul Kim ; Dae Young Kim, "Design of Fast Handover Mechanism for Multiple Interfaces Mobile IPv6", Wireless Pervasive Computing, 2008. ISWPC 2008. 3rd International Symposium, Page(s): 697–701, 2008
16. Mohamed Alnas, IrfanAwan, D.R Holton "Mechanism in Mobile IP", Published in:Cyber-Enabled Distributed Computing and Knowledge Discovery, 2009. CyberC '09. International Conference, Page(s):176 – 179, 2009
17. Mohamed Alnas, Irfan , and R Holton "A Survey of Handoff Performance in Mobile IP" Published in: EMS '09 Proceedings of the 2009 Third UKSim European Symposium on Computer Modeling and Simulation Pages 517-522 IEEE Computer Society Washington, DC, USA ©2009

18. Mohamed Alnas, IrfanAwan and D.R.W Holton "Performance Evaluation of Mobile IPv6 Fast Handover" Published in:IIT'09 Proceedings of the 6th international conference on Innovations in information technology Pages 211-215 IEEE Press Piscataway, NJ, USA ©2009
19. Nguyen Ngoc Chan "Mechanisms of Mobile IP in delivering packets and its trends for changing from IPv4 to IPv6", Published in: Advanced Communication Technology, The 9th International Conference, Volume:2, Page(s): 1027 – 1032, 2007.
20. QIAN Hong-yan, CHEN Bing, and Qin Xiao-lin "A Novel Mobile IP Protocol Supporting Roaming Subnet", International Conference on Networks Security, Wireless Communications and Trusted ComputingApril 25-26-2009
21. Ruidong Li, Jie Li ; Kui Wu ; Yang Xiao, "An Enhanced Fast Handover with Low Latency for Mobile IPv6", Wireless Communications, IEEE Transactions, (Volume:7, Issue: 1, Page(s): 334 – 342, 2008
22. Rajesh Verma, Rajeev Tripathi, and KshirasagarNaik "A Mobile IPv6 based Route Optimization Scheme for Mobile Networks" Published in: India Conference (INDICON), 2009 Annual IEEE, Page(s): 1 – 4, 18-20 Dec. 2009
23. Reza Malekian "The Study of Handover in Mobile IP Networks" Published in: BROADCOM '08 Proceedings of the 2008 Third International Conference on Broadband Communications, Information Technology & Biomedical Applications Pages 181-185 IEEE Computer Society Washington, DC, USA ©2008
24. RojaKiranBasukala, Kyu-Jin Park, Dong-You Choi, Seung-Jo Han "Secure Mobile IP Communication in Residential Networks" 2010 IEEE 24th International Conference on Advanced Information Networking and Applications Workshops Perth, Australia, April 20-April 23-2010
25. Soo-Duek Kim, Jong-Hyouk Lee; Tai-Myoung Chung, "Performance Analysis of Fast Handover Schemes for Proxy Mobile IPv6", Internet Multimedia Services Architecture and Applications (IMSAA), 2009 IEEE International Conference, Page(s): 1 – 5, 2009
26. SangjinJeong, Myung-Ki Shin "Route Optimization Scheme for Proxy Mobile IPv6" proceeding of: Advanced Communication Technology, 2008. ICACT, 10th International Conference, Volume: 21097 – 1100, 2008.

27. ShileiKuang, Robert Elz, and SinchaiKamolphiwong" Investigating Enhanced Route Optimization for Mobile IPv6", Computer Systems Architecture Conference, 2008. ACSAC 2008. 13th Asia-Pacific, Page(s):1 – 7, 2008
28. VasosVassiliou and ZinonZi "An Analysis of the Handover Latency Components in Mobile IPv6 of Internet Engineering", JOURNAL OF INTERNET ENGINEERING, VOL. 3, NO. 1, DECEMBER 2009
29. W. K. Lai and J. C. Chiu, "Improving Handoff Performance in Wireless Overlay Networks by Switching Between Two-Layer IPv6 and One-Layer IPv6 Addressing", IEEE Journal on Selected Areas in Communications, vol.23, no.11, November 2005
30. Young-Hyun Choi, Jong-Hyouk Lee, and Tai-Myoung Chung, "Route Optimization Mechanisms Performance Evaluation in Proxy Mobile IPv6 Published in: Systems and Networks Communications, 2009. ICSNC '09. Fourth International Conference, Page(s): 49 – 52, 2009

Books References

1. CiprianPopoviciu, "Deploying IPv6 Networks" [1st Edition] June 2006 Published Feb 10, 2006 by Cisco, Press Part of the Networking Technology series.
2. Christian Huitema, "IPv6: The New Internet Protocol, [2nd Edition] " 1996
3. Joseph Davies, "Understanding IPv6, [Second Edition]" Paperback, junuary 19-2008.
4. HeshamSoliman, "Mobile IPv6- mobility in a wireless Internet", 2008
   Qing Li, TatuyaJinmei, Keiichi Shima, "IPv6 advanced protocols implementation", Imprint: Morgan Kaufmann, Pages:008, 6-Apr-2007
5. Rajeev S. koodli, Charles E. Perkins, "Mobile inter-networking with IPv6-concepts, principles, and practices", Willy, 365 pages, 9-Jul-2007
6. Scott Hogg and Eric Vyncke, "IPv6 Security" [1st Edition], Published Dec 11, 2008 by Cisco Press. Part of the Networking Technology: Securityseries.
7. Silvia Hagen, "IPv6 Essentials" [2nd Edition], Publisher: O'Reilly Media, Pages: 438, May 2006.